



Restoring Fire Integrity

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MAIN QUESTIONS OR ISSUES THAT YOU ADDRESSED

Restoring Fire Integrity

LOCATION AND ECOSYSTEM INVESTIGATED

The terrestrial United States

KEY FINDINGS OF YOUR RESEARCH

For the first time in the history of the planet a single species is engaged in what we must call The Great Triage. All terrestrial lands in the U.S. are being irrevocably committed to one of three Conservation Domains:

Conservation Domain 1, “natural” consists of the 14 percent of lands permanently committed to preservation of natural values; our National Parks, National Wildlife Refuges, Wildernesses; portions of National Forests and BLM lands; all comparable state and local lands, and the lands of private conservation agencies. The threat of mass extinction means that restoring fire integrity to these lands is not optional: this must be done to prevent loss of at least 50 percent of plants, birds and animals in the U.S.

Domain 2 “multifunctional landscapes” and “working landscapes” encompasses the production lands where people make their living on ranches, range lands and other semi-natural landscapes that have the potential for preserving a modicum of scenic and recreation values as well as the more common 50 percent of species of birds, plants and animals. Domain 2 is the stage, around the planet, for learning how to live well and making our living sustainably on the land (Fischer et al. 2017).

Because truly natural fire regimes are incompatible with the working lands of Domain 2, and because livestock are poorly compatible with some half or more of the flora and fauna of rangelands, we must accept that survival of at least half of species diversity in the U.S. will depend on restoration of natural fire regimes to a close approximation of their historical range, adjusted for climate change, on the lands of Domain 1.

Domain 3, cities and other lands irrevocably transformed to human uses, includes urban lands—from the largest megalopolis to small towns and hamlets—with all their highways, factories, parking lots; their lawns and parks of global anthropophilic weeds. This domain also includes intensive row crop agriculture and intensive silviculture—the monofunctional lands committed to supplying the massive, thundering, incessant flow of materials into processing facilities and urban centers. Aggregation of remaining natural lands on small farms by corporate consolidators, who are running out of options for growth by acquisition, can be expected to convert much of Domain 2 lands to intensive use in the next two decades, eliminating the small pockets of natural communities they may still retain.

This research was presented at the 7th International Fire Ecology and Management Congress, which was held in Orlando, Florida, November 28-December 2, 2017 and was hosted by the Association for Fire Ecology, in cooperation with the Southern Fire Exchange.

The future of biodiversity conservation, which lies squarely in Domain 1, requires two new definitions:

Fire Dependent Species: A fire dependent species is any species of plant, bird or animal that will ultimately go extinct without fire.

By previous conceptions, a fire-dependent species was one possessing some evolutionary trick such as serotinous cones that open with the heat of fire to release seeds. This is only the tiniest tip of the iceberg. By our new definition, since a large percent of our flora, along with the arthropods, bird and animal species that depend on plants for food and habitat, requires regular fire to maintain open, sunny structure, something approaching half or more of all terrestrial species in the U.S. are threatened by fire exclusion. This is mass extinction in progress, almost unheeded by the conservation community in the conflict over climate change.

Fire Integrity is defined as fire moving freely through a landscape, through the seasons and years, at its natural frequency; displaying its customary range of behaviors; constantly renewing vegetation; stabilizing soil chemistry; removing dead fuels; renewing the complex multidimensional mosaic of species' habitats at all scales—AND interacting with the dynamic equilibrium of predators and herbivores—thereby sustaining the full diversity of terrestrial species from soil microorganisms to arthropods, birds, plants and animals; as it has done for over four hundred million years.

This may seem complex, but nature is complex; the ten points subsumed in the definition above should be considered parsimonious descriptors.

Why is Restoring Fire Integrity a new paradigm? The pre-European US was a frequent-fire landscape. With exception of the roughly 25 percent of the contiguous lands of the United States that is desert or mountainous, the remaining 75 percent contained substantial areas supporting very frequent fire, with intervals between 1 to 14 years (Guyette et al 2012, Frost 1998). These regions contained literally thousands of species dependent upon those frequencies to maintain their thousands of habitats. This is one of several lines of evidence indicating that at least 50 percent of all terrestrial species in the U.S. are, in the long run, dependent upon fire for survival.

The concept of Fire Integrity recognizes that

- fire integrity is a condition of the landscape, not a fire regime
- fire is a universal conditioning agent affecting soils, surface fuels and vegetation structure, and underpins the thousand individual species habitats on each site, even as they shift in relation to climate change
- only fire can perform the thousand tasks—chemical, micro and macro—that must be executed regularly in each natural area
- there is no surrogate for fire: nothing else comes even close
- in Domain 1, fire, like rain, is an indispensable component of environment and, like rain, is not made irrelevant by climate change, new trajectories of succession, or the “New Ecology”
- a species dependent on a 3-5 year fire interval historically is still dependent upon that interval today and will still be dependent on that interval another hundred years into climate change
- natural fire regimes, called historical range of variation or HRV in LANDFIRE, are as solid a requirement for natural diversity as precipitation
- when the time comes to provide assisted migration for a species that does not cross Interstates well, we must have new sites available with fully intact fire integrity, including the whole suite of species with which it has coevolved, and with numbers of deer, elk and other herbivores controlled to natural levels, ready to receive and support it.

Since fire frequency and species diversity are heavily modulated by herbivory, the paradigm integrates fire ecology with plant ecology and wildlife biology. Large herbivores and their effects on fire and species diversity remain warily ensconced in their academic burrows. The three fields interact to produce fire integrity, yet we can point to almost no good multifactorial studies. A recent study illustrates how little we understand these interactions. Fire reintroduced to a site in West Virginia produced abundant new germination and seedlings, but deer, maintained at something approaching five times pre-European numbers for recreational hunting, browsed it all (Nuttall et al. 2013). And grazers, by eating most of the grass fuel, can eliminate natural fire frequency. In order to deal with the accelerating mass extinction in progress we must acknowledge how very little we know about even a single species: we do not even understand deer—the wild species most unrelentingly beleaguered by biologists. For conservation of species diversity in the face of the twin threats of mass extinction and climate change these fields can no longer operate in isolation. The interactions that produce fire integrity open up “rich new pastures of ignorance” for study.

Figure 1 below illustrates the loss of 95% of fire-dependent species in the southeastern Coastal Plain, a second line of evidence for impending mass extinction.

Figure 1 shows a 245-year fire exclusion chronosequence for nine 1/10 ha plots on the same soil series (Craven loam) in eastern North Carolina. The plot on the left, JO03, with 68 species) had been burned in recent years on a three-year frequency in the Croatan National Forest, the estimated natural, pre-European fire frequency. The other plots had been fire suppressed or excluded from fire for various intervals back to 1772. All plots were documented, from historical information and from their position in frequent fire landscapes, to have historically supported open, sunny longleaf pine savanna with a continuous herbaceous grass-forb understory. The red line represents fire dependent species, such as wiregrass (*Aristida* spp.), the green shows fire-neutral species such as gallberry (*Ilex glabra*) that can be found in annually burned savannas as a tiny shrub 10 cm high, but also with trunks to 15 cm diameter on islands that never burned. Blue represents fire-refugial forest species. The last two plots were closed-canopy beech with white oak and tulip poplar on a site which was occupied by longleaf pine when advertised for sale in 1772. In the same county there had been exploitation of longleaf pine for tar, pitch and crude turpentine as early as 1622 (data from Frost 2000 dissertation).

Loss of fire integrity has resulted in complete turnover from an open, sunny, species rich, very frequent fire community to the uniformly dark, multistoried, species-poor woody thickets that have taken the eastern half of the country.

Within domain 1, processes that have accumulated to threaten mass extinction on “protected” natural lands in only a few decades include:

- Saturation of the historical landscape with European livestock, which interrupted the natural fire regime, beginning before 1800 in many areas, and submitted the entire national herbaceous flora to rearrangement into livestock “increasers” (thorny, unpalatable or toxic species) and “decreasers” (palatable and nutritious species), driving an unknown number of species to extinction and some half of U.S. plants into decline and rarity. This process continues today where cattle are found on public lands.
- Predation exclusion, elimination of the natural predator/herbivore dynamic balance—which once included Native American hunters—has released herbivores to decimate herbaceous plant species diversity;
- Modern fire exclusion
- Intentional herbivore multiplication, especially deer and elk, to near carrying capacity for vegetation by State game agencies has created pressure on species diversity never experienced in the natural world. Herbivore overpopulation, interacting with fire exclusion, threaten herbaceous species and forest structure throughout the U.S.

Our failure—during two decades of increasing focus on climate change—to distinguish for the public and the conservation community the prevalent dependence of species diversity on fire in the US and the advancing wave of mass extinction, has resulted in dangerous muddling of Conservation Domains 1 and 2. Since the fate of some half of plant species and the animals that depend on them in the U.S. requires returning fire and its interacting components of the natural predation/herbivory dynamic to Domain 1, restoring fire integrity for preventing mass extinction deserves to be a crucial conservation mission on an equal par with climate change.

In contrast to recent assertions to the contrary (Freeman et al. 2017), we are now able to reconstruct natural fire regimes and historic range of variation (HRV) at broad brush scales (Guyette et al, 2012, Frost 1998) for any point in the country and at local scales as precise as 1-3 years in this savanna or 3-5 years on that south-facing hillside (Frost 2013). These are the fire frequencies upon which species depend and that dependence cannot be expected to be substantially affected by climate change.

While largely irrelevant for the working landscapes of Domain 2, restoring Fire Integrity to our protected natural lands is our only hope for avoiding loss of perhaps half of total species diversity in the U.S. in the impending mass extinction of the next few decades.

HOW MIGHT/WILL IT INFLUENCE FIRE MANAGEMENT DECISIONS OR PRACTICES?

Provide information to help AFE and other conservation agencies restore major funding to address the twin issues of mass extinction and climate change when the political pendulum swings our way again.

WHO IS THE MAIN END-USER OF YOUR RESEARCH?

An enlightened future Congress and all public and private agencies managing our protected natural lands.

CONGRESS SESSION

Restoring Fire Integrity: A New Paradigm Arises from the Ashes, Cecil Frost.

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